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Easier Ways

OF HANDLING

GROUND FEED

ON THE FARM

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CONTENTS

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EASIER WAYS OF HANDLING GROUND FEED ON THE FARM

R. H. BAKER and R. A. BAILEY

SUMMARY AND CONCLUSIONS

In feeding grain, the typical Ohio livestock feeder handles 25 to 100 tons or more of feed grains each year.

There are some general things that any feeder can do in order to process and handle his feed more economically and with less effort.

Plan the storage of grains and feed at points that are the most convenient for the next operation.

Move grain and feed as short distances as possible.

Sack grain and feed as few times as possible. Handle in bulk form unless it is necessary to sack it. Packaging and unpackaging takes time.

Use feed carts and carriers to reduce travel, effort and time in feeding.

A one-man plan of feed grinding is usually most efficient.

Grind large batches of feed, 1800 to 3000 pounds every week or two instead of 400 to 600 pounds every few days.

Pre-mix grains and supplement before grinding if grinding at the farm. Then the mixed feed can be blown directly from the grinder into overhead feed storage. With overhead feed storage the feed can be dropped into feed cart, trailer or in some cases into self feeders.

Grain can be shovelled out of storage into a truck, trailer or wagon faster than it can be carried in a basket or sacked and carried. Conveniently placed doors and openings help make this job easier. Bins located high enough that grain can be spouted into wagon or truck can save considerable time. Small elevators may be used to advantage in some instances.

If practical, purchase large enough amounts of protein supplements to qualify for quantity discounts.

Arrange feeding area; self feeders, troughs or mangers so they are most convenient for the feeder. If placed so they can be filled in one circuit through the feeding area it may save a considerable amount of needless backtracking.

A power take-off driven unloading trailer can save lots of time and effort if sizeable amounts of feed have to be hauled to self-feeders on pasture or range. It can also be used if ground feed has to be delivered to feed rooms at several locations.

In grinding poultry and hog feed it may be possible to plan a system where the feeds flow into an electric powered grinder almost automatically without anyone in attendance after the process is started.

INTRODUCTION

Handling of feed on livestock farms is a bigger job than many people realize. On most, the daily livestock chores take up one-half or more of the operator's working day. As a part of these livestock chores, the feeding jobs make up about one-fifth of dairy chores, one-half of hog chores and three-fifths of poultry chores.

If a farmer keeps 10 sows and grinds the shelled corn for their spring and fall litters he will grind about 56 tons of feed a year. If he has a herd of 25 dairy cows he will grind about 33 tons and mix a total of some 40 tons of feed. For a flock of 1,000 hens he will grind 45 tons and mix 66 tons. Shelling corn for hogs and chickens represents additional tonnage to be handled. On many livestock farms in Ohio the operator grinds from 75 to 100 tons of feed each year.

Home-grown grains that are fed to livestock weigh two to three times as much as all of the liming materials[1] used each year by Ohio farmers. And these home-grown grains that are ground are handled (lifted and carried) five or six times or more from their points of storage until they are delivered to the animals that eat them. Commercial feedstuffs are probably handled two or three times by the farmer who uses them. If one considers the number of times that feed is handled, farmers carry 15 to 20 times as many tons of feed as the tonnage of liming materials applied.

One doesn't carry lime a long distance with legs, arms and back. It is handled as few times as possible. If it is spread by the farmer a lime spreader is used.

Many different livestock feeding methods are used by farmers in Ohio. Some require much more effort and time than others to prepare and deliver each hundred pounds of ground feed to the feed troughs.

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[1]In 1950 Ohio farmers bought 1,623,320 tons of liming materials. In the same year they fed 134,500,000 bushels of corn, 29,000,000 bushels of oats, 8,000,000 bushels of wheat, 550,000 bushels of barley, and 230,000 bushels of soybeans. About 1,000,000 tons of commercial feedstuffs are purchased by Ohio farmers each year.

With some feeding arrangements and locations of buildings and storage, the feeding system requires that feed be handled many times between storage at harvest time and the point it is fed to animals. On some farms, feed is handled and rehandled, packaged and unpackaged two or three times, lifted and carried many times, and loaded and unloaded (on a trailer, truck or wagon) several times; while on other farms where the same quantity of feed is used, feed handling is accomplished with fewer steps, less time, and only a fraction of the lifting.

The systems that require the most time and effort do not necessarily result in any greater gains or production per unit of feed.

Feeding and Processing Problems Vary. Ohio is an important livestock state. Hogs, dairy cattle, poultry, and beef cattle are all important enterprises. These classes of livestock and the many different feeding methods in use present different feed processing and feeding problems.

Steer feeders usually grind ear corn which is fed in the form of corn and cob meal without any mixing. Protein concentrates are fed separately on top of the corn and cob meal. Some steer feeders prefer to grind their corn with a burr mill in order to have a minimum of very fine material in their feed.

Hog feeders may either hand-feed or self-feed. They may feed either ear corn, or ground or whole shelled corn, or some combination of these. About one-half of the feeders feed ear corn most of the time. Only about one-third to one-fourth of the remainder feed whole shelled corn. The others who grind shelled corn may mix a protein supplement with it or may feed the supplement free choice in other self feeders.

Most poultry feeders feed mash to their hens and feel that it requires more careful mixing than does the feed for other livestock. All corn for chickens is shelled. A few flocks are fed whole grains and supplement in separate hoppers and the birds are permitted to mix their own rations.

Men with dairy herds as a general rule grind and mix ear corn, oats, protein supplement and minerals.

Purpose. Feeders have often asked for comparisons of the necessary labor, effort, investment and expenses of handling feed by different methods. Questions have been asked about the economy of home grinding and mixing of livestock feed.

In order to provide answers to some of these questions this study was conducted. It is hoped that some suggestions have been included which will be helpful to feeders in improving their own systems.

This study deals with problems associated with the processing and feeding of concentrate feeds such as grains and supplements. Some of the same problems are faced in the feeding of roughages and succulent feeds such as hay and silage but they will not be discussed at any length here. Some of the same types of solutions suggested here will apply equally well to roughage handling problems.

The feeding of ear corn is not specifically covered in this study. Many hog men who feed ear corn have found that the location of portable cribs at the point where corn is to be fed is a very desirable practice. These cribs can be built in such a manner as to be used as self feeders. A sled-like feeding platform can be located next to the self-feeding crib and reduce the waste of shelled corn.

GRAIN STORAGE

Location of grain storage cribs and bins greatly influences the convenience of feed processing and feeding jobs. On many farms the corn cribs, small grain bins, the feed grinding and mixing area and the livestock feeding areas are in separate buildings. If grinding is done on the farm, ear corn and small grains must be hauled to the grinder from two or more different locations, and the ground feed must be hauled or carried to the feeding area. If ear corn or shelled corn is fed it too must be hauled to the feeding point. When grain is ground at an elevator or feed mill the whole grains must first be assembled. It takes time and effort to hitch a wagon to a tractor, to haul the wagon from point to point, to unhitch and belt the tractor to a hammer mill and to unbelt and hitch to the wagon again.

Ideally, the grain storage, processing and feeding areas should be adjacent to each other (Figure 1). Whole grains can either flow by gravity or be conveyed directly from storage to the grinder or sheller and the processed feed can be blown into storage bins (often overhead) or dropped directly into a cart or wagon. Time consuming hitching, unhitching and hauling can be substantially reduced on many farms with this general arrangement.

Many corn cribs and grain bins are constructed for maximum convenience in filling but with little regard for later removal of the grain. A given quantity of ear corn, for example, can be shovelled into a wagon faster and easier than it can be sacked or placed in baskets. Yet in many cribs it is almost impossible to remove the corn other than by carrying it out in a basket. Hinged doors or a section of removable slats along the side of the crib at floor level make it possible to shovel the corn out. Time, lifting and carrying can all be reduced with very little expense.

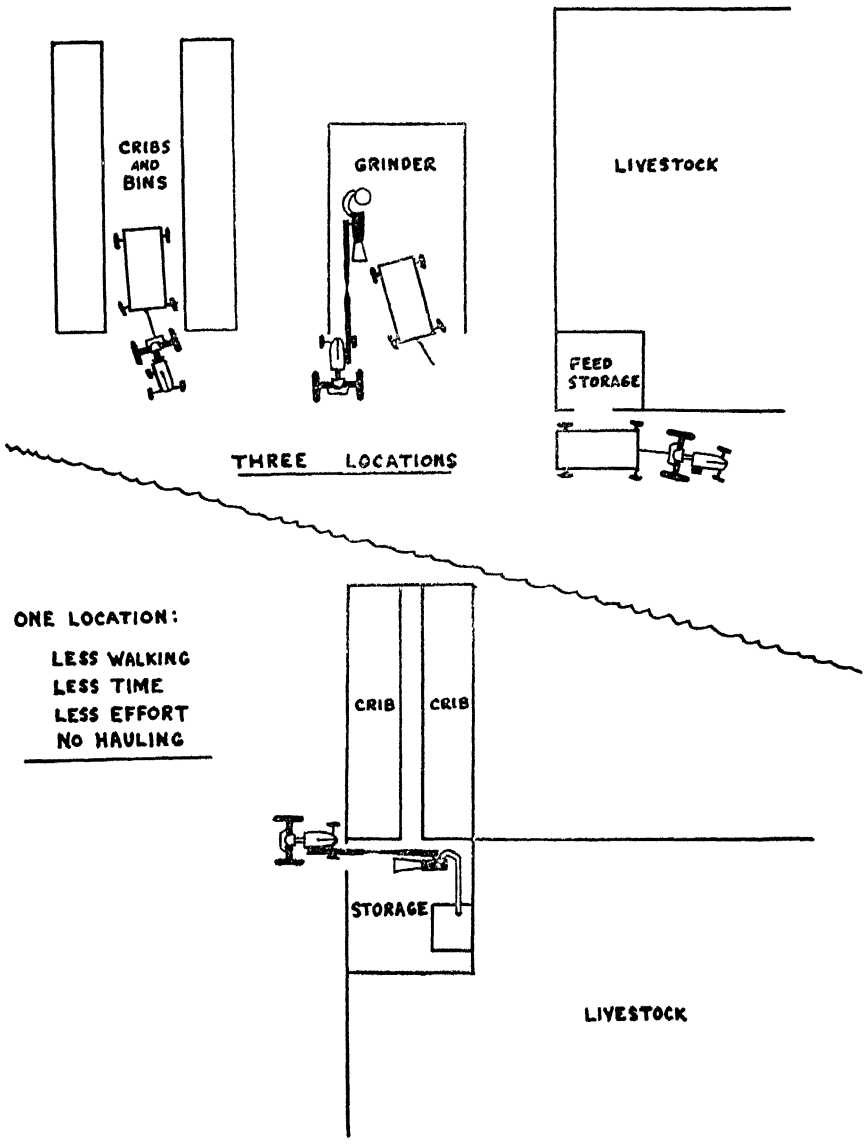

Fig. 1.—The arrangement in the lower half of the illustration where storage, processing and feeding areas are adjacent is ideal. Any effort to combine them will help save time and labor.

For maximum convenience small grain bins should be located overhead so that they can be emptied by gravity. If grinding is done on the farm a convenient location for bins is over the grinder. Grain can be spouted down directly into the grinder or be diverted into sacks or a wagon for other uses. In cases where it is impossible to install bins above the grinder, or if feed is ground at a commercial elevator a desirable location is in or near the corn crib. Corn and small grains can then be loaded at one spot, without the necessity of moving the grain.

Some farms on which large quantities of feed are handled are equipped with drags, elevators and other power equipment to reduce the labor required in removing ear corn from storage. In some cases, the cost of this equipment may be greater than the value of the labor saved. Investment in such equipment is justified when the resulting time saved is worth more than the cost of the equipment, when the dollars invested could not be used to better advantage elsewhere, or when the operator is in a financial position to place a personal value on avoiding lifting and heavy work.

THE FEEDING JOB

Different classes of livestock present different labor problems in feeding grain. Hogs and poultry can be self-fed. Steers are sometimes fed only once a day. Dairy cattle are usually fed grain at each milking. Feeding practices also vary with different building arrangements and management methods. For example, the job of feeding dairy cattle in a full stanchion barn is different than feeding in a milking parlor. Each individual farm has a different set of feeding problems.

Even with these differences there are some broad principles which can be applied to many feeding situations. An ideal feeding system should make it possible to deliver the feed to the animal at the right time with a minimum of effort, time and cost. The various means which efficient livestock feeders have of achieving this goal can be summed up in a few general recommendations:

(1) Keep the distance feed must be moved to a minimum.

(2) Use rolling friction and other substitutes for the human back.

(3) Move feed in large loads. They are generally more efficient than small.

(4) Build up livestock numbers to an efficient size. Many jobs take little more time for 20 animals than for 10. This may mean fewer types of livestock on a farm.

Fig. 2.—Overhead bins and carts will same many miles of travel. Storing the mixed feeds at the point where they will be used makes other steps easier.

The five main things that have to be done in feeding, after the feed is ground and mixed are; store it, remove it from storage, transport it to the point it is to be fed, deliver it into trough or feeder and the operator has to return to the point of origin or move on to another job.

Ground Feed Storage. Storing mixed feed at the points that are the most convenient for feeding, makes the next steps in feeding much easier. Feed can be hauled or carried to feed bunks, troughs or feeders in less time if the storage bins are located as close as possible to the feeding point.

Some feed is hauled from the processing area directly to self-feeders without ever going into storage. In a few instances it may even be blown directly from the grinder into self-feeders or into bins located overhead above self-feeders.

It is helpful if the feed processing area can be located close to the feeding area where the ground and mixed feed can be blown into an overhead storage bin from which the feed can flow into a cart.

If an overhead bin with a bottom having a 60 percent slope is used for feed storage it is possible for feed to flow by gravity into a cart, carrier or wheelbarrow, thus saving the effort and time of emptying sacks or shovelling out of a bin.

Some farmers blow feed from the grinder into these overhead bins. Others may use a grain elevator.

A few men with bank barns have bins that empty into carts on the ground floor but are filled from truck or wagon on the main floor. The top of some of these bins are truck height—convenient to dump sacks or shovel into. One poultry man has a vertical storage bin that will hold 7½ tons of mixed feed in a bank barn that is used as a three story laying house. This bin is filled with an auger conveyor from a hopper at truck height. The feed drops from the large storage bin automatically into the hopper of an automatic feeder that serves all three floors.

Several dairymen with bank barns have hammer mills on the main floor of the barn that blow feed into a mixer located 10 to 12 feet above the hammer mill. A vertical bin which will hold over two batches of mixed feed is located under the mixer. Feed from this storage bin drops into a feed cart in the basement. Sometimes there are other smaller holding bins between the mixer and the main floor to store poultry and sow feed. The spouts from these bins are high enough that bulk feed can flow into a trailer or into a sack.

A poultry feed storage bin in the hen house can often be placed where it can be filled from outside the house. Feed can be drawn from this bin into a bucket. The filling opening can be at a convenient height for truck, wagon or trailer.

If it isn't possible to have overhead feed storage it helps to place sacked feed on an elevated platform. Then it is possible to dump feed into a cart with less lifting. The storage point should be one that is close to the place feeding takes place.

It sometimes happens that the granary building, where feed is ground and mixed, is centrally located among the other farm buildings. Some feeders store all feed there and at each feeding carry the necessary amount to the dairy barn, hen house, sheep shed and hog house. This is an inefficient way to handle feed. It requires more time and walking as well as a great deal more energy to carry each day's feeding, than if it were delivered when processed to a convenient feed storage area in each barn.

Hauling Feed to Livestock. Using carts in feeding can make the job easier and faster. With carts, larger loads can be moved in feeding without undue effort. Much less walking is required. All unnecessary sills and obstructions that will interfere with the use of carts should be eliminated.

Feed carts are particularly suited to use in dairy barns. Carts enable dairy farmers to do the grain-feeding job in less time and much less travel and effort than when baskets or buckets are used. On some

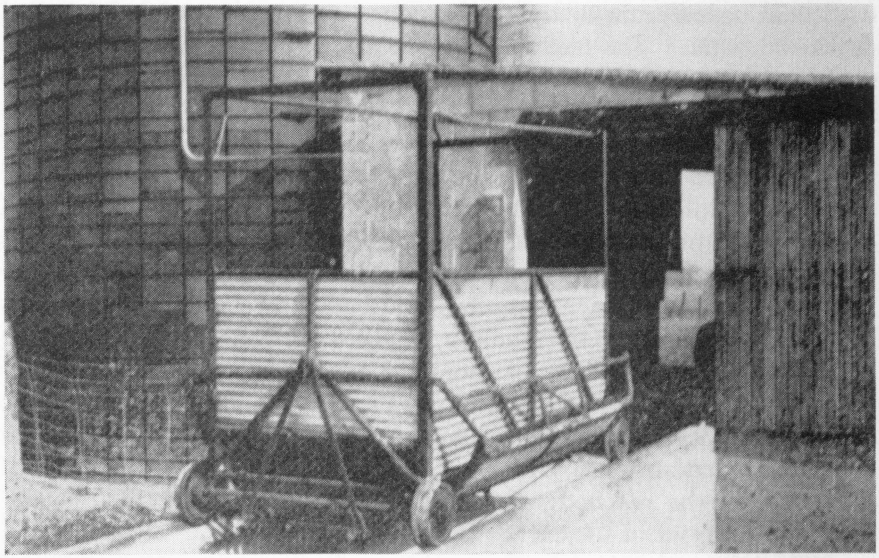

Fig. 3.—A homemade silage cart with unloading panels underneath and the cart built to fit the feed bunk will reduce labor and feeding time. Note the unloading panel projecting out to one side.

dairy farms studied, the men who did not use carts traveled 75 percent farther and spent 15 percent more time in feeding concentrates than did the men who used carts. In feeding grain to a 20 cow herd the use of a cart in a full-stanchion barn saves about 150 feet of walking each feeding. To make the use of a cart most effective, they should be large enough to hold enough grain for an entire feeding, there should be aisles that will permit circular travel and it should be possible to fill the cart by gravity from overhead storage.

Wheelbarrows with high sideboards are sometimes used to good advantage when aisles are too narrow for conventional carts. Cost can be held down by using the same cart for feeding both grain and silage.

In a study of dairy herds fed in milking parlors it was found that only about 60 percent as much time and travel were required to feed grain as in the conventional stanchion barns. When the ground feed is stored overhead where it can be spouted directly to the feed box in the milking stall, feeding can be done in about five seconds per cow.

Many types of feed carriers can be used in feeding beef cattle. A rubber-tired wheelbarrow can be used if the feed bunks are all connected. The bunks begin at the point of feed storage. The wheelbarrow can be filled from an overhead bin. In about five minutes 75

cattle can be fed grain by tipping the wheelbarrow forward as it is rolled down the bunk. The feed is spread in a fairly uniform layer over the silage. It can be mixed with the silage with a fork or the feeder can use his feet. Silage can be fed in this same manner.

Several farms near Toledo have the feed storage at one end of the feed bunks and the silo near the other end. Wheelbarrow loads of silage are hauled across a drawbridge to the feed bunks and spread evenly in the bunks by tipping the wheelbarrow forward. The drawbridge is raised when not in use so the cattle can move freely to either side of the bunks. These operators feed both silage and ground feed to 60 to 80 steers in 15 to 20 minutes twice a day.

Ordinary overhead track-mounted litter carriers are frequently used, but have the disadvantage that feed must be shovelled or scooped out by hand. They are more efficient than baskets, since larger loads can be carried and less energy is used in feeding. Higher levels of efficiency can be reached when the feeder does not have to stop and scoop the feed out of the carrier by hand.

The edges of a feed bunk can be used as rails for a cart to carry loads of ground feed and silage.

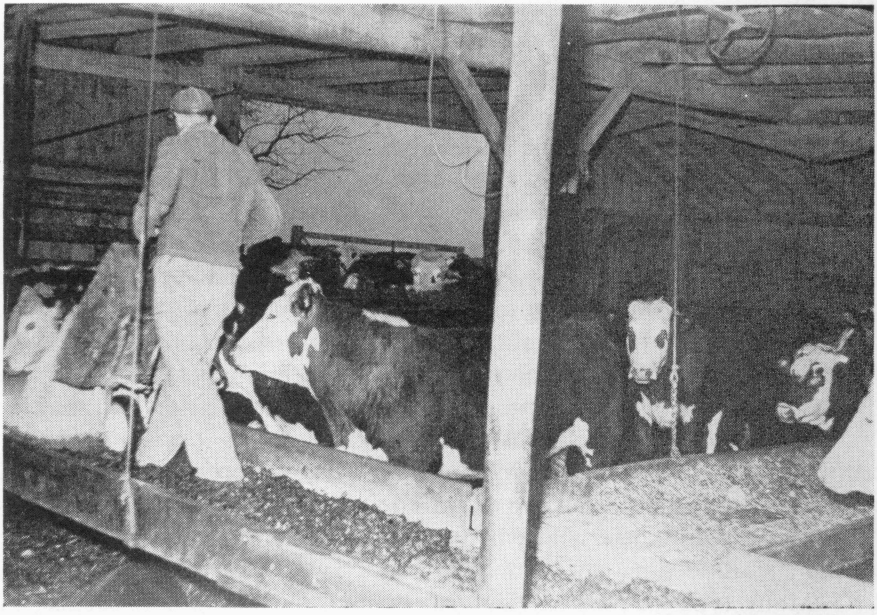

Fig. 4.—In the feeding methods, wheelbarrows of feed are pushed across and then tipped forward to spread the feed evenly over the bunk. As many as 80 animals can be fed in 15 to 20 minutes.

Some feeders have designed and built feeding carts and carriers that are hand-power emptied or permit feed to fall through cut-off openings in the bottom of the cart. One central Ohio beef feeder uses a track-suspended carrier that has a hand crank driven web in the bottom of the carrier box. The ground feed is fed out of one end of the carrier box. That end of the carrier is closed by a swinging door that is hinged at the top. Feed is spread along the bunk by the operator turning the crank as the carrier is pushed along. This type carrier will hold more than most wheelbarrows and thus requires a little less time in feeding. It has another advantage in that feed bunks do not have to be continuous as long as the overhead track serves them.

In laying houses containing 500 hens or more, if one can use an overhead track supported carrier to haul feed in and eggs out of pens, this will save time, steps and energy. An abandoned hay track and car

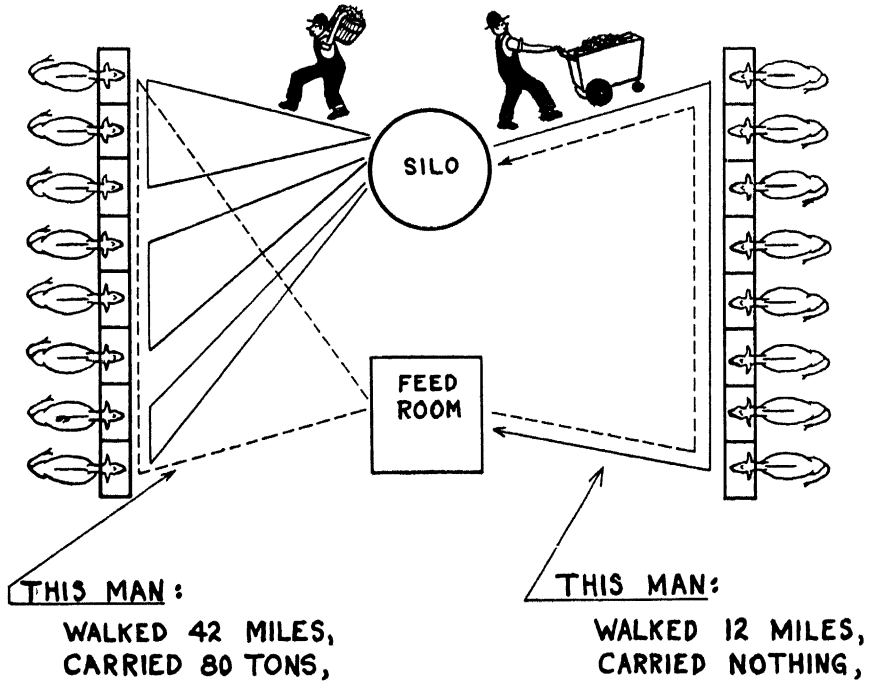

Fig. 5.—The man on the right took care of 16 cows by walking only 12 miles a year while the operator on the left carried 80 tons of feed and walked 3½ times as far doing the same job.

can often be used for this purpose. The carrying device may be an open platform upon which buckets of feed and baskets of eggs may be placed.

Bunks or feeders whether in barns or on range can be placed close together to reduce the distance feed must be carried. If they are arranged near fences, drives, or feed aisles, it may be possible to empty feed into them without opening gates or doors.

If the work routines and the order in which jobs are done have been well thought out feeding fits into the entire chore routine more efficiently. Trips can be combined and one can follow the principle of "doing a job when they have to be in that area anyway." Circular travel with a minimum of back-tracking and traveling back and forth is one very desirable goal.

Special Feeding Trailers. Some feeders have either built or bought special feeding trailers or truck beds. Many of these units have augers or conveyors for unloading. Most of these units are designed to handle small grains, shelled corn or ground feed. A few can also handle silage and some mix silage and ground feed as it is fed to the animals. These special grain handling trailers have been built in different sizes

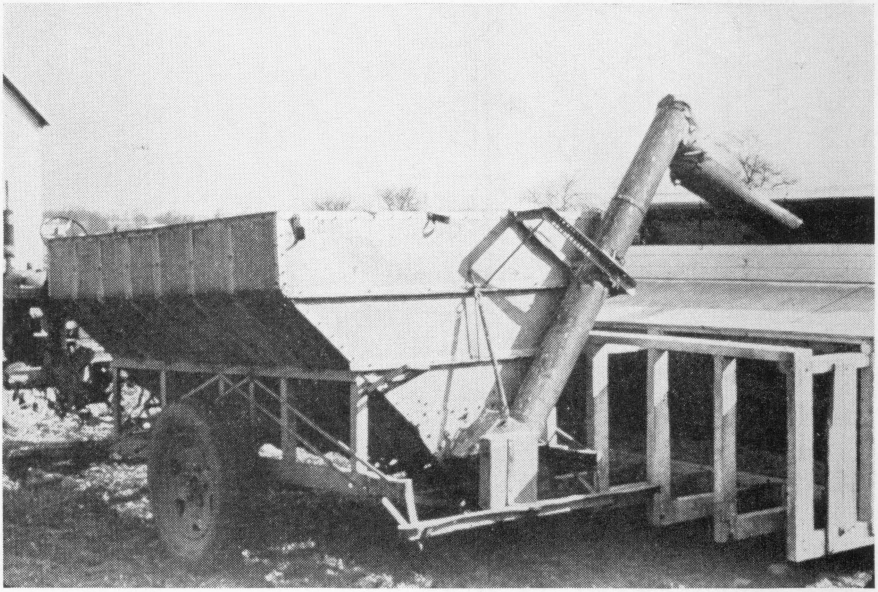

Fig. 6.—This arrangement makes it possible to convey the feed into the bunk directly from the trailer without the added labor of shovelling the feed.

depending on the need. One type, used with beef cattle, is built so that it has a sloping bottom and is high enough that feed can be delivered into feeding bunks by gravity without a conveyor. It is loaded from an overhead feed storage bin and feed is placed in five feed bunks for 72 heavy cattle in 15 minutes. This time includes getting the trailer, loading, opening gates, cleaning and moving feed bunks as well as feeding.

A power unloading trailer may cost from $250 to $400 to build or buy. If it cost $400 the annual charge for its use would be about $62, not including the cost of power.

It may be that at present a tractor and wagon are being used to haul ground feed to self feeders or to other barns. If so, there would be no additional power cost with the use of the unloading trailer. At 80 cents per hour labor, savings of 78 hours per year would equal the annual cost of the trailer. If used the year around a daily saving of 13 minutes would balance the cost of the trailer. If only used during the six months of barn feeding it would take daily savings of 25 minutes (or three hours a week) to equal the 78 hours.

The tractor to power this trailer may be an extra cost over the present feeding method. If it is charged at 85 cents an hour for fuel, depreciation, repairs and overhead and the unit is used about 300 hours per year the total cost, not including labor, would be $317 per year. If labor is valued at 80 cents per hour it would take a labor saving of 396 hours per year to make this practice an economic investment. This would be equal to 65 minutes per day.

ELEVATOR GRINDING SERVICE

An elevator or feed mill, if it does any feed grinding and mixing, usually has one or two men ready to serve customers wanting such services. Farmers are often heard to complain that it is a common thing for them to spend half a day or more getting feed ground because they have to wait one or two hours or more at the elevator.

Several establishments were visited to time the flow of customers for a half day or entire business day. It was found that most elevators render prompt service. Only a few serve more than an average of two grinding customers per hour and on most days they only average about one customer per hour. From 10:30 a. m. to 2:30 p. m. is usually the busiest period. Customers arriving before 9:00 a. m. seldom have to wait to be served. On busier days between 9:00 a. m. and 4:00 p. m. a customer may have to wait up to a half hour. Some days of the week are busier than others. Saturday often is one of the busiest. During

the periods of peak demand for field work it is a common experience to find a heavy demand for elevator grinding service on rainy days or other days when it isn't possible to work in the field.

Most elevators have 60-75 horsepower electric motors powering their grinders and can grind a 1,200 to 1,500 pound batch of feed in ten minutes or less.

One fairly typical elevator in western Ohio on a typical mid-week fall day in 1951, ground and mixed 21 different batches of feed for customers. These customers lived an averaged of 4¼ miles from the elevator. The average batch of feed weighed 1,106 pounds, of which 807 pounds was farm grown grain. The remainder, 94 pounds of shelled corn, oats or wheat and 205 pounds of commercial supplement or bran, was purchased from the elevator.

The average time spent by each customer waiting to be served was just under five minutes. The time required to unload, grind, mix, sack, load up and pay the bill for each customer was just over 20 minutes.

Another elevator in central Ohio, where records of customers served over a three week period in August 1951 were available, showed very similar performance. During that period one-half of the batches of feed ground were under 1,100 pounds. There were more jobs of 500 pounds than any other size. Only one-tenth of the customers had over 3,100 pounds ground. They averaged 24 customers for grinding service each day. August generally produces 20 to 30 percent more grinding business than the average for the year.

The rate charged by the elevator for grinding and mixing varies over the state. In some communities it may be as low as eight cents per hundredweight while in others it may be as high as 20 cents. The most common charges were found to be ten and 12 cents in western Ohio and 15 cents per hundredweight in northeastern Ohio.

A large proportion of the elevators and feed mills use their trucks to perform pick-up and delivery services as well as doing the grinding and mixing. The elevator's truck hauls the corn and other farm grown grain to the elevator and after grinding and mixing according to instructions, returns the mixed feed to the farm. In northeastern Ohio, it is a common practice to pick up the grain as the ground feed is delivered. The grain is then stored at the elevator for a week, ground when convenient and is ready to be delivered to the farm when needed or when the truck is delivering in that territory. Usually an extra charge of from five to ten cents per hundredweight is made for this pick-up and delivery service.

Some elevators will deliver an order of mixed feed that was made up of corn and oats on hand at the elevator. They take in exchange

corn and oats from the farmer's storage. A few feeders object to this practice because of the chance of getting grain of lower quality in the exchange.

If elevator grinding service is used, one should arrange, if possible, to be there at times when there will be a minimum of waiting. By loading up the day before it is often possible to arrive at the elevator early enough that no waiting is necessary.

It takes about an hour, including the time spent loading the grain and unloading feed and travel to and from the elevator, to have a 700 pound batch of feed ground at most elevators and in less than two hours a batch of four times that size can be handled.

Bulk Delivery of Feed. At most elevators it is possible to bring in corn or other grain in a bulk form and empty the truck, trailer or wagon into a pit from which it is conveyed to the grinder. It usually is a time saving practice at the farm to shovel grain into a truck or trailer rather than to have to sack it and load it. The quantities can be determined by the numbers of shovels full.

A very few mills have facilities to also return the ground or mixed feed to the farmer's truck in a bulk form, eliminating the need for sacking it. This can be a convenience for a farmer if his facilities for handling it at his farm are adequate.

Some elevators might have to add an overhead bin or two to enable them to deliver bulk mixed feed to the farmer's truck. This could speed their flow of customers and save some of the mill operator's time usually spent sacking feed. If the farm is equipped to handle bulk feed the mill with bulk facilities can be of greater service to those customers.

Companies, that also build lime spreading truck bodies, have developed truck beds to deliver large quantities of bulk ground feed to the farm and unload it into feeders or overhead bins with a power take-off driven auger.

Some barns are arranged so the feed in a bulk form can more easily be emptied and stored than if it were sacked. It may be that in a bank barn, a truck equipped with a hoist bed can empty the bulk feed into a truck height bin which in turn permits the feed to be dropped by gravity into a cart or carrier on the floor below. Often times bulk feed can be elevated to overhead storage as conveniently or more easily than sacked feed.

There are a few feeders who have trucks or trailers with auger unloaders that can move feed directly to self-feeders or feed bunks with great savings in time required for handling.

Not many Ohio farms are at present equipped to handle their feed need in a bulk form. Some of those handling larger quantities might find it desirable to do so.

Cost of Elevator Grinding. In addition to the fee paid for the grinding service there needs to be some charge for the use of a truck or other transportation facilities, and some allowance for the labor spent in loading the grain, unloading the ground feed, travel to and from the mill and waiting on its grinding. Because some items of costs are about the same whether 500 pounds or a ton is to be ground, the cost per hundredweight will be lower if larger batches are taken each trip.

About five minutes are spent getting the truck out, getting ready to load grain and putting the truck away after the ground feed has been unloaded. It takes about two minutes per mile to haul to the elevator. The average distance feed was hauled to the elevator was about four miles. It costs about eight cents a mile to operate a small farm truck. It requires a little over one minute per hundredweight to load the grain if shovelled on and about 25 seconds per sack to unload at the farm. At the elevator the average time spent in waiting to be served and paying the bill after the job is completed is about eight minutes. The time required for grinding, mixing, sacking and loading was about eight minutes plus one minute (1½ minutes for poultry feed) per hundredweight.

TABLE 1.—Time Required and Cost of Processing Different Size Batches of Feed if Ground at Elevator or Feed Mill

	Amount of feed prepared each trip*					
	1000	1200	1400	1600	1800	2000
Time required: minutes						
Getting truck or trailer ready	3	3	3	3	3	3
Shovelling corn	6	7	8	9	10	11
Shovelling oats	3	4	4	5	6	6
Haul 4 miles to elevator	8	8	8	8	8	8
Waiting at elevator	8	8	8	8	8	8
Grinding, mixing, etc.	16	18	19	21	23	24
Hauling feed home	8	8	8	8	8	8
Unloading	3	4	5	5	6	7
Put truck or trailer away	2	2	2	2	2	2
Total time	57	62	65	69	74	77
Cost:						
Labor charge @ 80¢ per hr.	$ .76	$ .83	$ .87	$ .92	$ .99	$1.03
Custom charge @ 12¢ per cwt.	.97	1.17	1.37	1.56	1.75	1.95
Transportation @ 8¢ per mile	.64	.64	.64	.64	.64	.64
Total cost per batch	$2.37	$2.64	$2.88	$3.12	$3.38	$3.62
Cost per cwt.	$ .237	$ .22	$ .206	$ .195	$ .188	$ .181

*Farm grains about 81 percent of total mixture.

The cost of taking grain to the elevator to have a 1000 pound batch of feed ground and mixed is about $2.40, including the loading, unloading, hauling and a charge for waiting at the mill. A batch three times that large would have a total charge of about $4.80. The smaller load would bear a charge of 24 cents per hundredweight while the larger load would be about 16 cents per hundredweight.

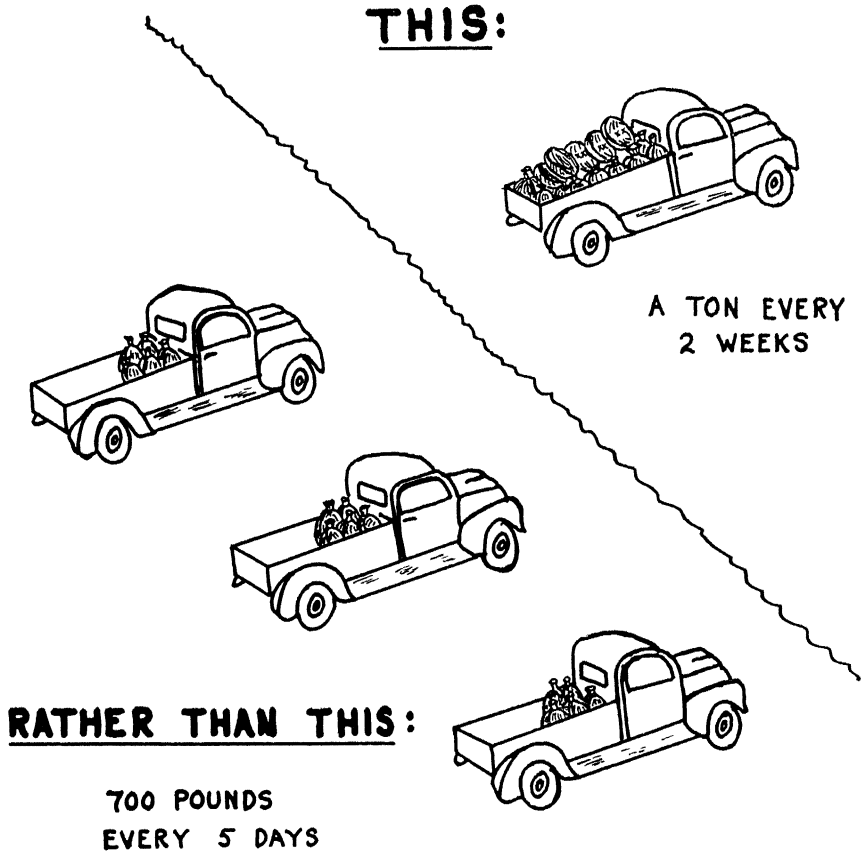

Fig. 7.—Since the transportation cost is about the same whether 500 pounds or a ton of feed is hauled in for grinding, it is much more economical to make one trip with a larger load.

PORTABLE GRINDING SERVICE

Portable grinders, mounted on trucks, render custom grinding and mixing services in a few communities in Ohio. A feeder who employs these services does not have any investment in grinding or mixing

equipment nor does he have to own a truck or trailer to transport the grain or mixed feed. On days when the farm operator is very busy with field work or not at home, the custom operator furnishes all labor that is necessary.

Some feeders have not used portable custom grinders because breakdowns cause outfits to get behind schedule. This may result in being out of ground feed.

The custom operator usually will only render service if the feeder purchases supplements that he sells. These purchases in small quantities, a few sacks, usually do not qualify him for any quantity discount.

Custom rates charged were found to be from 18 to 25 cents per hundredweight. Since the farmer usually helps and spends about 1½ minutes per hundredweight of feed ground, this would add about two cents more per hundredweight to the cost.

HOME FEED PROCESSING

Many different arrangements for grinding and mixing farm grown grains on the farm are commonly used. Most of those doing their own grinding use a hammer mill. A large number of them have factory built upright auger-type mixers from which the feed is sacked, after supplements have been added. A few men have smaller hammer mills that are powered by five or 7½ horsepower electric motors. But a more usual practice is to use a farm tractor to run a nine to 13 inch hammer mill. This grinding and mixing equipment is usually located either in a double crib, the granary or on the barn floor. On many farms the grinding and mixing job is considered to be a two-man job. The more efficient units observed in this study were arranged so they could be operated with one man. Considerable differences in man hours spent per ton to grind feed were found. With tractor powered home grinding units some men spent as little as 52 minutes per ton while others spent as much as three hours per ton. One-half of those who were timed spent a little less than 75 minutes per ton.

Most of the men with low labor inputs per ton had their grain stored close to the grinding area. A few had mixers located some place above the grinder. Feed, when mixed, could then flow into a truck or storage bin or be sacked if so desired.

A few men have grinding units that are portable and driven with the tractor power take-off. These units can be taken to the point of feed storage such as a temporary crib. Some hog feeders take both the shelled corn and the grinding unit to the self-feeders and blow the ground feed directly into the feeders. If grinding must be done at

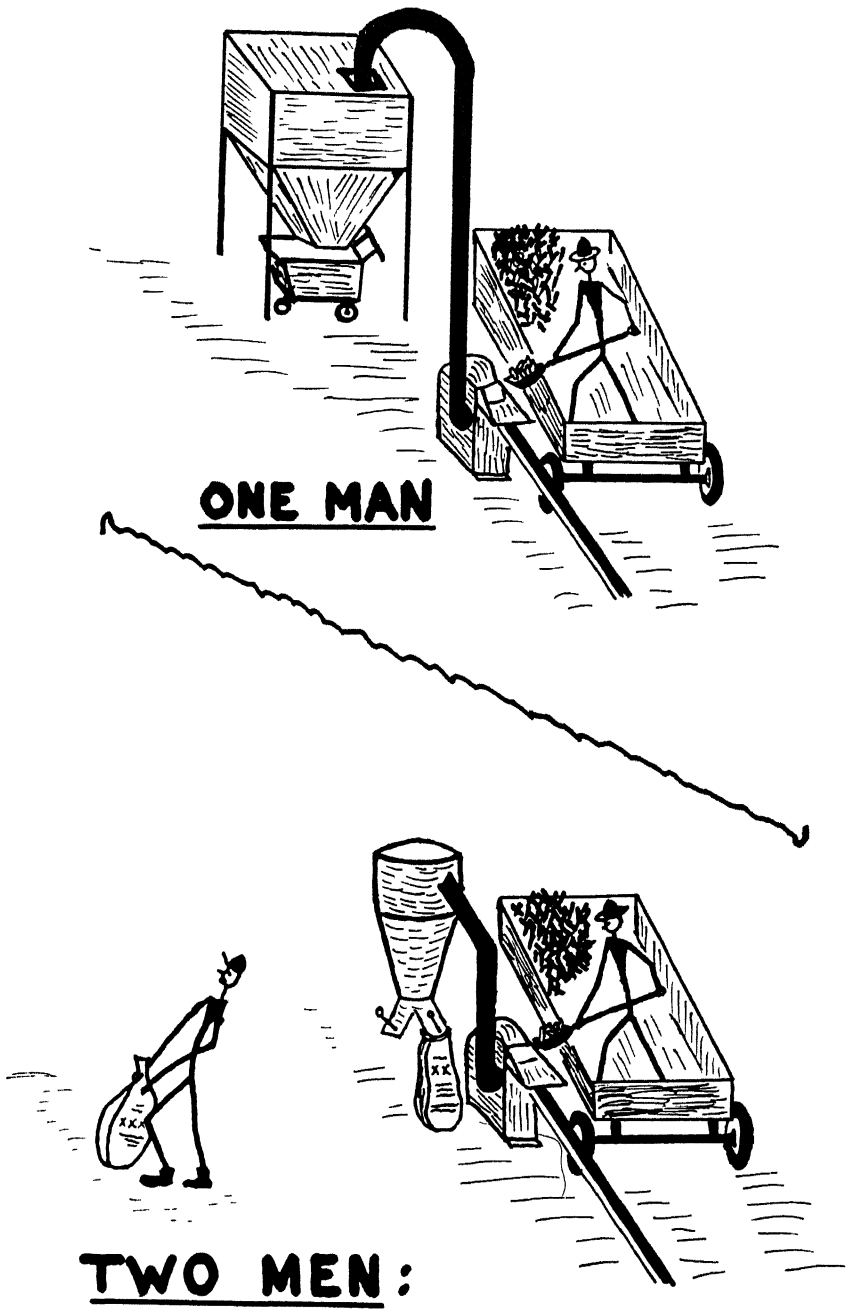

Fig. 8.—Here, with a proper storage bin, one man can do the same amount of grinding as two men when one has to carry away the filled sacks. Later feeding will be quicker by getting feed from bin.

several sets of buildings or if the ownership of grinding equipment is shared by two or more farm operators, a portable power take-off driven mill may be much more economical than fixed installations at each farm or bringing all feed to one farm for processing.

It usually takes as much time to grind an average batch of feed with your own equipment as it does to haul the grain to your grinder, mix after grinding and haul to the point of use.

Grain (except ear corn) can be spouted into a grinder where it can be regulated to flow almost automatically. This can be done more easily with hog and poultry feeds. Some men use small electric powered mills to do almost automatic grinding to good advantage. These small units have lower initial costs and lower operating costs per ton if the operator is free to do other jobs. The smaller capacity per hour means that the unit just runs more hours per week.

Feed Mixing. The problem of mixing livestock feedstuffs is not handled in the same way by all feeders. A few do no mixing before feeding. They either permit the animals to make cafeteria-like selections such as shelled corn and protein supplement for hogs, or place two or more different types of feed in the same feed trough in layers in the same way that beef cattle feeders feed corn-cob meal with some protein supplement spread on top.

Others insist upon complete mixing after grinding and choose to have a commercial elevator or feed mill with their larger mixers do the job. This is quite often true for poultry feed. Most grains ground for dairy cattle and poultry are mixed in some manner with supplements and minerals. Some also have mixers of different sizes that will handle batches of feed from 800 pounds to a ton.

Another method of mixing feed that is often used is to mix the grains and concentrates before grinding. This pre-mixing is either achieved by blending of the ingredients in a hopper above the grinder, or on the feed table of the grinder, or if the grains are hauled to the grinder, they may be spread in layers in the trailer, truck or wagon. The concentrates can be spread over the top of load and the aggregate can be shovelled into the grinder where it is mixed as well as ground.

Hand mixing is time consuming.

Some feeders perform the mixing process by spreading different feedstuffs in layers on the floor in a feed room. As feed is shovelled into a cart a blending is achieved.

Home Versus Elevator Grinding. One problem that is often faced is whether it is less expensive to own feed grinding equipment or to use an elevator's custom grinding service.

Several factors have a bearing upon the decision. The amount of capital available, the quantity of feed to be ground each year, the distance to an elevator, and the building arrangement on the farm are all very important.

Another important consideration is the labor available on the farm. On some farms, it may be possible for one man to do the necessary crop and livestock jobs, if the feed processing job is done by the elevator even if the total cost per ton of doing so seems to be a little higher.

On other farms, already requiring the time of two or more men, it may be cheaper to grind at the farm even though total cost per ton is a little higher, in order to make use of man hours that otherwise might not be fully utilized.

Suppose the farm is located about four miles from an elevator. When all costs are considered, including an allowance of 80 cents per hour for the time spent by the farmer in processing the feed, if about 25 tons of feed a year are ground and mixed there is little difference in total cost whether a feeder has his own equipment or has an elevator do the feed processing job for him.

How much is 25 tons of feed a year? If an average amount of supplement is added it is about 750 pounds of farm grown grain each week.

Most farmers who are equipped to process hog, cattle and poultry feed have a hammer mill that is tractor powered and a batch feed mixer powered by an electric motor.

If they have less than 25 tons a year to be ground and mixed it probably will be cheaper to use the services of an elevator or feed mill. Sometimes feeders with more efficient arrangements for storage and feed handling can do their own grinding at lower cost than with a custom service even if only 15 or 18 tons are ground each year.

In these comparisons it is assumed that corn and oats were stored near the grinding and mixing area and that the mixed feed had to be moved to a near-by building. It assumes a fairly well arranged feed handling system similar to types commonly found on many farms. Labor rates were figured at 80 cents per hour. Tractor charge was 52 cents per hour to cover variable expenses of fuel, oil, grease and a small amount for repairs. No overhead charges such as depreciation, interest, insurance, taxes or housing of the tractor were included in the charge for belt work because the tractor is owned primarily for field operations. The annual machinery expense, as explained in Table A, was $18.50 for a ten inch hammermill and $26.80 for a 1000 pound mixer. If about 25 tons of feed are ground and mixed a year each batch of 1600 pounds should bear a machinery charge of 59 cents for the grinder and 86 cents for the mixer.

If corn has to be shelled before it is ground it will add about 2½ to 3 cents per bushel or about 40 cents per 1600 batch to these costs if a one man crew is used.

Each feeder, by substituting his own job speeds and power and equipment costs in Tables 2 and 3, can select the method of feed handling that is least expensive for his farm. Particular barn arrangements, types of equipment, distance to elevator or custom charges may result in a little different set of comparative costs.

TABLE 2.—Comparison of Cost of Processing a Batch of 1600 Pounds of Ground Feed by Different Methods if About 25 Tons of Feed are Processed Each Year

	Home grinding		Elevator grinding		
	Tractor power	Electric power	Farmer hauls	Elevator truck hauls	Portable custom grinder
Get tractor ready and belted up	5	—	—	—	—
Get truck or trailer ready to haul	—	3	3	—	—
Sack corn	13	13	—	13	13
Carry sacked corn to grinder	4	4	—	—	—
Grinding corn	23	40	—	—	—
Empty supplement into mixer	3	3	—	—	—
Carry oats to grinder and grind	8	15	—	—	—
Wait on mixer to blend feed tractor unbelted and belt put away. 2 batches	6	6	—	—	—
Sacking from mixer (17 sacks not tied)	6	6	—	—	—
Shovel corn into truck or trailer	—	—	9	—	—
Shovel oats into truck or trailer	—	—	5	—	—
Sacking oats	—	—	—	4	4
Haul grain to elevator	—	—	8	—	—
Waiting at elevator to be served	—	—	8	—	—
Elevator grinding, mixing, etc.	—	—	21	—	—
Hauling feed home	—	—	8	—	—
Feed loaded on trailer	5	5	—	—	—
Feed hauled to barn	1	1	—	—	—
Feed unloaded at barn	5	5	5	—	—
Tractor and trailer put away	2	—	—	—	—
Put truck or trailer away	—	2	2	—	—
Total time spent; minutes	81	103	69	17	17
Labor charge	$1.08	$1.37	$ .92	$ .23	$ .23
Custom charge	——	——	1.56	2.86	3.12
Transportation	——	——	.64	——	——
Power	.40	.19	——	——	——
Equipment	1.45	1.98	——	——	——
Total cost per 1600# batch	$2.93*	$3.54*	$3.12	$3.09	$3.35

*If corn has to be shelled for hog or poultry feed add about 40 cents per batch for home shelling.

Comparisons can be made of the cost of processing feed by different methods using wage rates higher or lower than the 80 cents per hour used in earlier illustrations. Some men may not consider their labor a cost. In Table 4 the first column shows a comparison of costs if no allowance is made for labor. Even if no charge is made for labor, home grinding with a tractor furnishing the power is less expensive than the other methods.

Pre-mixing Before Grinding. One way to lower costs with a home grinding unit is to manually mix the feed stuffs before grinding instead

TABLE 3.—Cost per Ton for Grinding and Processing Different Quantities of Feed by Different Methods

Method of processing feed	Quantity of feed ground and mixed each year					
	15 tons	20 tons	25 tons	30 tons	40 tons	50 tons
Home grinding with tractor:						
Equipment	$3.02	$2.26	$1.81	$1.51	$1.13	$ .91
Power	.50	.50	.50	.50	.50	.50
Labor	1.35	1.35	1.35	1.35	1.35	1.35
Total cost per ton	$4.87	$4.11	$3.66	$3.36	$2.98	$2.76
Home grinding with electric power:						
Equipment	$4.13	$3.09	$2.48	$2.06	$1.55	$1.24
Power	.24	.24	.24	.24	.24	.24
Labor	1.71	1.71	1.71	1.71	1.71	1.71
Total cost per ton	$6.08	$5.04	$4.43	$4.01	$3.50	$3.19
Grinding at feed mill. Grain and feed hauled by the farmer:						
Custom charge			$1.95			
Truck			.80			
Labor			1.15			
Total cost per ton			$3.90			
Grinding at feed mill. Mill hauls grain and delivers feed:						
Custom charge			$3.57			
Labor			.29			
Total cost per ton			$3.86			
Grinding at the farm with portable custom grinder:						
Custom charge			$3.90			
Labor			.29			
Total cost per ton			$4.19			

of having to mix them after grinding. This eliminates one expensive piece of equipment. The mixed feed usually has to be sacked and transported, all of which takes time.

Not many farms are arranged so grain storage, feed processing and feeding point are located adjacent to one another. Either grain has to be hauled to the grinder or the ground feed has to be hauled to the feeding area. If pre-mixing is practiced it is more desirable to locate the grinder where the ground and blended feed can be blown by the grinder into a storage bin convenient to the principal feeding area. This saves the time of sacking and carrying or hauling if mixed in a mechanical mixer after it is ground.

Pre-mixing can be done in several different ways. If shelled corn, oats and supplement are stored in bins above the grinder they can be blended on the feed table or in the hopper of the grinder or in a holding bin over the grinder. Quantities of the different feeds can be measured by having chutes with upper and lower gates or shutoffs. The upper gate can be just far enough above the lower to contain 20 pounds, 25 pounds, 30 pounds or any desired quantity of that feedstuff in that section of the chute. A 500 pound batch could be made up of eight 30 pound units of shelled corn, eight 20 pound units of oats and ten 10 pound units of a protein concentrate. If these units are dropped on the feed table or in a hopper in rotation a very satisfactory blending of the ground feed will occur.

Pre-mixing can be done on the floor near the grinder and shovelled from there into the grinder. Since it often happens that the grain has to be hauled to the grinding area it is possible to spread the oats, supplement and mineral over the top of the load of ear or shelled corn and shovel directly from the truck, wagon, or trailer into the grinder. This procedure will meet the needs of most farms.

If grain has to be hauled to the grinder and the ground feed hauled to self-feeders it may be possible to spread the pre-mixture towards the

TABLE 4.—Cost per Ton of Grinding and Processing 25 Tons of Livestock Feed per Year by Different Methods at Different Wage Rates

Method of handling feed	Wage rate per hour			
	No charge	$0.50 per hour	$0.80 per hour	$1.00 per hour
Home grinding—tractor power	$2.31	$3.15	$3.66	$4.00
Home grinding—electric power	2.72	3.79	4.43	4.86
Elevator grinding	2.75	3.47	3.90	4.19
Elevator grinds and transports	3.57	3.75	3.86	3.93
Portable custom grinder	3.90	4.08	4.19	4.26

back part of the wagon bed and have the ground feed returned to the front part of the wagon. As more space is cleared in shovelling into the grinder more space is available for ground feed.

If pre-mixing is practiced it makes it very easy to do the grinding and mixing job with a one man crew and have equipment operating to capacity all of the time.

Electric Versus Tractor Power for Grinding. The type of power that is best adapted to any particular farm depends upon the grinding needs.

Electricity is a cheaper source of power than is gasoline.

Most farmers find that their electric lines will permit them to use no larger than a five horsepower electric motor, or in some cases, one as large as a 7½ horsepower. Most two plow tractors deliver 25 to 35 horsepower on the belt. This greater power operating the grinder permits more grain to be run through the grinder per hour than when a 5 or 7½ horsepower electric motor is used.

If electric power is used, grinding is ready to be started with the flip of a switch. With tractor power for grinding, some time is spent in getting the tractor started, moved into position, belted up and when the grinding is finished, unbelted and the tractor put away. Most farmers spend six to eight minutes on these functions.

A five horsepower electric motor will run a grinder an hour for about 12 cents worth of electricity and will grind from 40 to 70 percent as much feed as when a two-plow tractor is used with a little larger mill. The fuel and oil costs for an hour of tractor grinding will be about 45 cents.

TABLE 5.—Home Grinding 1600 Pound Batch of Pre-mixed Feedstuffs

Operations	Time	Cost
Tractor and wagon ready to load	3	
Shovel corn into wagon	9	
Shovel oats into wagon	5	
Spread supplement over load	3	
Haul to grinding area	1	
Belt up tractor	2	
Shovelling pre-mixture into grinder	31	
Unbelt and store belt	2	
Put tractor and wagon away	2	
Total labor	58 minutes	$ .77
Tractor		.36
Grinder		.59
		$1.72

Although electricity is a cheaper source of power than gasoline it may be that depreciation and overhead plus the extra time required (because of slower grinding rates with only a five horsepower motor) will make tractor power as cheap and in most cases cheaper than an electric motor when all costs are considered.

Some work is being carried on to develop automatic systems of grinding and mixing. These include: electric powered grinders, mixers and conveyors, electric timers, regulators and controls.

Some men have feed grinding arrangements where grain flows automatically into an electric powered grinder and after once being started can be left unattended, permitting the operator to do other chores, until the batch of feed is finished.

One man was observed who did this using a six inch hammer mill powered by a five horsepower electric motor to grind 3000 pounds of corn. Shelled corn flowed from an overhead bin into the grinder and was blown into a large mixer without anyone being with the equipment after the job was started. Another with similar equipment ground 2000 pounds of mixed shelled corn, oats and supplement. These feeds were mixed before grinding and were blown into a trailer to be hauled to self-feeders. Here too, the operator started the operation and then went on with his other chores. About five minutes before it was through he returned to finish up the job.

Labor costs may be 25 to 50 percent of grinding cost. If a system can operate automatically without someone being present, a considerable saving in grinding cost can be affected.

ARRANGEMENT FOR ONE-MAN OPERATION

One-man feed processing arrangements are generally more efficient in the use of labor than are those requiring two or more men. On units where a large volume of feed is handled, one-man operation is sometimes made possible by the use of automatic metering, grinding, mixing, conveying and feeding devices. On other smaller units the volume of feed processed is not large enough to justify much investment in such automatic devices.

Many of these smaller units are not equipped with mixers. This is also true of larger farms where unmixed ground feeds are fed or where grains and concentrates are pre-mixed in some way. If the feed is sacked after grinding, as it frequently is, some labor efficiency is lost on these units.

The typical grinder has no storage or holding chamber for the ground feed. Feed must be sacked just as it is ground. If one man does the grinding he must let the equipment run empty while he

removes the sacks. Even when the sacks are moved only a minimum distance from the mill it takes about one-half minute to remove the full sack, set it aside and replace it with an empty. The most common alternative is to use two men on the job. Labor efficiency is low in this case since one of the men will be standing idle part of the time.

An ideal way of making an efficient one-man operation out of home processing is found when storage, processing and feeding areas are close enough together that the whole grains can be shovelled or dropped directly to the grinder and blown from the grinder to an overhead bin in the feeding area. One beef feeder successfully piped ground ear corn 75 feet from his hammer mill to a bin in the feeding area by using a blower from an old silo filler. A western Ohio dairyman, by using an oversize blower on a 15 inch hammer mill, piped ground ear corn and oats 20 feet vertically and 30 feet horizontally from his grinder to an overhead mixer and feed bin in the feed room in another building.

When arrangements such as these cannot be used it is possible to construct an inexpensive overhead bin with a sloping bottom in the processing area. Feed may be blown into the bin as it is ground, so that one man can do the grinding without stopping to fill and move sacks of feed. The feed can be sacked at the end of the grinding operation or, when circumstances permit, can be dropped directly into a bulk carrier without sacking.

STUDY PRESENT METHODS

It is particularly difficult to prescribe one feed handling pattern that can be used on all farms equally well to accomplish maximum efficiency. Differences in types of livestock being fed, the existing building pattern and the particular feeding system all have a part in determining what methods are best for any particular farm.

But some desirable general principles that apply to all feed handling, as well as many other jobs, should be considered in selecting a good feed handling plan.

Many times feed processing and feeding are done in a time consuming, difficult and more costly way because the operator has never thought about possible changes. He follows a system because it has always been done that way on that farm. Improvements may be possible if present methods are analyzed and a study made of some proposed changes.

In analyzing the present method being used on any farm and studying the proposed changes for a better system of handling livestock concentrate feeds it might be well to think in terms of the principal things to be done with feed after it is harvested and stored. The six usual functions are: removal from storage, moving to grinder (or

sheller), grinding, mixing, moving to ground feed storage and feeding. Next, it is helpful to break these functions down into the jobs that are performed. Each job should be carefully studied and there are four steps that will be helpful in working out a better plan.

The first step is to know in detail how the job is now being done. Analyze it. Write down each part of the job as it is done by the present method. Include travel between jobs. Also include getting ready to do the job and cleaning up afterwards.

Next, question why the job is done in that way. Why is each move made? Is every one necessary? Can any portion of the job be eliminated or simplified? Can any parts be combined to advantage? Can the job be done with one man instead of two? Is there any better combination of men and machine?

The third step is to develop a plan for an improved method of performing these necessary functions. It may be that the work areas where these jobs are done can be rearranged or relocated to advantage. Can grain, ground feed or the grinder be located at more convenient points? Are the feed bunks placed where feeding is not an unhandy job? Will an elevator or overhead storage make feed grinding an easy one-man job? Can a cart or carrier be used to an advantage?

And the fourth step is to test and **use** the improved method. All of the effort spent in analyzing the job can be wasted if no application is made of the improved method.

The function of this analytical process is to develop the easiest, most effective method and **order** for doing the necessary work. At the same time it should find the most convenient and **economical** tools, equipment and facilities to do the job most effectively.

In working out new ways of doing these jobs it is important to examine capital as well as labor inputs. A new method may save one-half hour per week and not require any additional capital investment or cash operating expense. Another method may save one hour per week and 15 minutes each day or an annual savings in time of 143 hours. When first considered, this saving, if figured at 80 cents per hour, might seem like an annual savings of $114.40. The new method might necessitate an investment of $240. It might be charged off over the next 20 years at $12.00 depreciation each year. Another $2.40 a year might be set aside for repairs of this new equipment.

If profitable use can be made of the 143 hours saved the new method should result in an annual net savings of $100. But if the time saved is not used the net effect of the new method is some additional leisure time and an increase in annual operating expenses of $14.40 and an additional capital investment of $240.

TABLE A.—Investment and Annual Cost of Operating Feed Handling Equipment

Equipment	1952 cost	Probable life	Annual charge for use to handle 25 tons of feed					
			Depreciation	Repairs	Taxes	Housing	Interest 5%	Total
10″ hammer mill	$180	20	$ 9.00	$2.50	$ .81	$1.70	$ 4.50	$18.50
6″ hammer mill	120	20	6.00	2.00	.54	1.00	3.00	12.50
5 h.p. electric motor	315	30	10.30	2.50	1.42	.50	7.88	22.60
2000# mixer w. motor	630	30	21.00	3.00	2.84	2.50	15.75	45.00
1000# mixer w. motor	360	30	12.00	2.00	1.62	2.20	9.00	26.80
500# mixer w. motor	270	30	9.00	1.00	1.22	2.00	6.75	20.00
Sheller	150	25	6.00	2.00	.67	1.45	3.75	13.90
18′ chain elevator w. motor	300	25	12.00	4.00	1.35	1.45	7.50	26.30*
16′ auger elevator w. motor	250	25	10.00	3.00	1.12	.75	6.25	22.10*
Feed cart: 16 bushel	75	25	3.00	1.00	.34	——	1.88	6.20

*These elevators may be used at harvest or to store wheat or beans. If so, the feed handling charge should only be a portion of this total annual charge.